

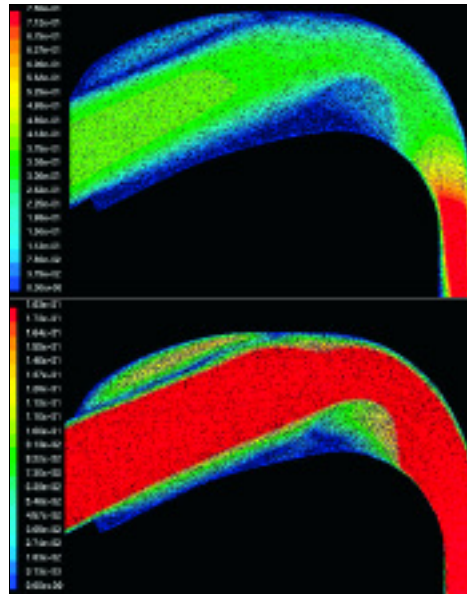
Ideas on the Edge

Massive Problems and Multiple Processors

A HIGH-PERFORMANCE COMPUTING FACILITY AT QUEEN'S UNIVERSITY IS CRACKING PROBLEMS THAT CAN'T BE SOLVED IN A REGULAR LAB.

Quick: what does the human throat have in common with an industrial smoke stack and the Pacific Ocean?

The answer is no joke. All three present significant problems involving fluid dynamics. And all three are yielding their secrets to scientists through the computational might of Ontario's High Performance Computing Virtual Laboratory—HPCVL.



High-performance computer models of air flow in the human throat will lead to more effective inhalers.

Based at Queen's University in Kingston, HPCVL offers high performance computing services to researchers across Ontario and elsewhere in Canada.

Dr. Andrew Pollard of Queen's University in Kingston, has been using the resources of HPCVL for five years now in his research into the behaviour of high-speed currents of air. It's an area that has application in the design of objects as diverse as industrial smoke stacks and asthma inhalers—and Dr. Pollard has worked on both. "The factors involved are very complex," he explains. "Empirical

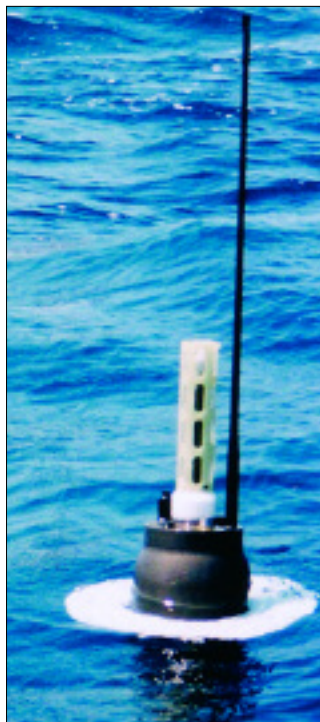
lab studies can't handle them. Only mathematical models can deal with all the variables, but that takes computing power."

And that's where HPCVL comes in. The central cluster of 11 Sun computers delivers the power of 408 processors and 1.2 terabytes of memory. By 2008, the number of processors will grow to 2,200, enabling the system to perform a staggering 18 trillion operations per second.

The Ontario Innovation Trust provided more than \$5 million for the facility—an investment that will stretch the envelope of fundamental research in Ontario—and provide real-world results. Dr. Pollard's model of the human throat, for example, will help design inhalers that deliver medication much more efficiently.

A few kilometres from Dr. Pollard's lab at Queen's,

Argo sensors—over 2,000 world-wide—spend most of their time at a depth of up to 2,000 metres, but surface regularly to transmit data via satellite. Canada is contributing to the international Argo effort by launching sensors in the Gulf of Alaska.



PHOTOS COURTESY OF JAPAN ARGO AND CANADIAN ARGO PROJECT

"We've never left the table."

A long-term partnership with Sun Microsystems

"How do you create something that's lasting, as opposed to providing a big box with a four-year lifespan?" That was the question Doug Girvin of Stantive Solutions asked himself as he prepared a proposal to provide HPCVL's high performance Sun workstations. Stantive is the Sun distributor for southeastern Ontario.

The answer was to offer an ongoing partnership that involved not just equipment, but also a dedicated systems engineer, generous scholarships for researchers, and training for academics in how to get the most from the facility. "When the transaction was done," Girvin explains, "we just never left the table." One result of Sun's continuing involvement is that HPCVL's utilization rates are more than twice as high as the average for similar facilities.

Sun also benefits from the partnership through opportunities to watch how their technology performs in research settings that push systems to the limit. "They punish our equipment," says Girvin, "so they've been phenomenal alpha and beta testers."

Project: High Performance Computing Virtual Laboratory
Institution: Queen's University (plus four other academic partners)
Research Discipline: Multidisciplinary
Principal Investigator: Andrew Pollard
Trust Investment: \$5,189,000
CFI Investment: \$5,189,000
Total research investment from all sources: \$15,030,859

Project: A Secure Multidisciplinary High Performance Computing Virtual Laboratory for Innovative Research
Institution: Queen's University (plus four other academic partners)
Research Discipline: Multidisciplinary
Principal Investigator: Douglas Mewhort
Trust Investment: \$8,845,591
ORF Investment: \$3,990,849
CFI Investment: \$12,836,440
Total research investment from all sources: \$49,496,033



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- jobs and prosperity in the future by strengthening Ontario's leadership in the key global information processing sector

Dr. Michael Stacey of the Royal Military College is working on another project involving fluid dynamics—but on a much larger scale. Dr. Stacey is using data from the global Argo network of floating sensors to build a

model of marine weather in the north-east Pacific. The welter of sensor information can only be analyzed with powerful computer resources. "We couldn't do any of this," Dr. Stacey says, "without HPCVL." The models he's building may one day make it possible to accurately predict the state of the ocean, resulting in safer shipping and therefore fewer environmental spills.

The power of HPCVL, however, isn't limited to engineering and the natural sciences. Queen's psychologist Dr. Doug Mewhort has used the facility to build a model of how the brain stores information and memory. And at age 61, he has very personal reasons for valuing the system's immense capabilities. "It's enabling me to get things done in my lifetime that

I didn't think would happen for another 20 years."



Infrastructure for Innovation About the Ontario Innovation Trust

The Ontario Innovation Trust was created in 1999 by the Government of Ontario to invest in research equipment and facilities at Ontario's universities, colleges, hospitals and other non-profit research institutions. The Trust is governed by a volunteer Board of Directors, according to the terms of a Trust agreement established by the Ontario government. A small permanent staff looks after day-to-day operations.

Since its inception, the Trust has committed almost \$843 million to strengthen Ontario's position in the global marketplace of ideas. This represents more than a third of the \$2.44 billion in total funding that has been invested in Trust-supported projects.